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ABSTRACT

These instructional objectives have been selected from materials submitted to the Curriculum Laboratory of the Graduate School of Education at UCLA. Arranged by major course goals, these objectives are offered simply as samples that may be used where they correspond to the skills, abilities, and attitudes instructors want their students to acquire. These objectives may also serve as models for assisting instructors to translate other instructional units into specific measurable terms. (MB)

Instructional Objectives for a Junior College Course in Electronics

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Los Angeles, California

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UNIT I

Electrical Units: Charge, Potential Difference, Current, Resistance

The functions of electric circuits are performed by the movement of charges. To understand these functions, it is necessary to study the basic particles of charge.

Electricity is explained in terms of the units of charge, voltage, current, and resistance. Understanding these units is necessary for the study of electric circuits.

Objectives

I. Goal: The student will understand the physical basis for electrical charge, potential difference, current, and resistance.

Objective: 1. Given illustrations of atoms showing the nucleus and electrons in orbital rings, the student will write on the illustrations the positions and values of charges. He will also indicate whether the atom represents a conductor or a semiconductor. 70

2. The student will define the following terms: element, electron valence, shell, nucleus, atomic number, conductor, insulator, semiconductor. 70

3. Given fifteen multiple choice items concerning electronic charge, potential difference, current, and resistance, the student will answer twelve correctly. Sample item: The opposition encountered by free electrons in motion is represented by

A. current.
B. charge.
C. resistance.
D. potential difference. 75

II. Goal: The student will understand the units and symbols of charge, potential difference, current, and resistance.

Objective: 4. Given a list of ten electrical terms and symbols, The student will select the correct unit name associated with the term or symbol. 100

5. The student will show, at the blackboard, the correct solution for at least 6 of problems 1-8 on page 30 of the Grob textbook. 75

6. Given a set of 10 problems on units of electricity, the student will solve at least 7 correctly 70

III. Goal: The student will understand the basic elements of a closed circuit.

Objective: 7. The student will list three important elements of a closed circuit. He will state the function of each element in 25 words or less. 70

UNIT II

Direct-Current Sources

Electrical circuits require a source of energy for operation. Two forms of direct-current sources are the battery and the photovoltaic cell. An understanding of the characteristics of direct-current sources is necessary in applying these sources to circuits in the laboratory.

Objectives

I. Goal: The student will understand the characteristics and applications of batteries and photovoltaic cells.

Objective: 1. In the laboratory, the student will construct the circuits and perform the measurements and calculations on d-c source connections and internal resistance in Experiment No. 3 of the Fiske and Harter laboratory manual. He will complete the information on the data sheet included in the manual. 80

UNIT III

Ohm's Law and Power Equation

Ohm's law expresses the relation between voltage, current, and resistance. Power may be expressed in terms of voltage and current. An understanding of these two relations is essential in circuit analysis.

Objectives

I. Goal: The student will understand and be able to apply Ohm's law.

Objective: 1. The student will write the three forms of Ohm's law. 100

2. Given 5 graphs showing the relation between two of the terms (E, I, & R), the student will calculate the fixed value of the remaining term. 80

3. The student will show, at the blackboard, the correct solution for 5 of the following 6 problems on page 45 of the Grob textbook: 1, 3, 4, 6, 7, 9. 83

4. Given 10 multiple choice items on the application of Ohm's law, the student will answer 8 correctly.
Sample item: What value of resistance is connected to the terminals of a 100-volt power supply if 50 ma flows through the resistor?

A. 5 ohms
B. 2000 ohms
C. 2 ohms
D. 5000 ohms 80

II. Goal: The student will know the relations between power, work, voltage, and current.

Objective: 5. The student will write one equation showing the relation between power, work, and time and another equation showing the relation between power, voltage, and current. 100

6. Given 5 multiple choice items on power, the student will answer 4 correctly.
Sample item: What is the total power consumption of a 100-watt light bulb which burns 5 hours a night for 10 days?

A. 2 kwhr
B. 5000 kwhr
C. 200 kwhr
D. 5 kwhr 80

III. Goal: The student will understand power dissipation in resistance. He will be able to apply Ohm's law in combination with the power equation.

Objective: 7. Starting with Ohm's law and the equation for power in terms of voltage and current, the student will make appropriate substitutions to show power dissipation in terms of voltage and resistance and power dissipation in terms of current and resistance. 100

8. The student will show, at the blackboard, the correct solution for 3 of the following 4 problems on page 45 of the Grob textbook: 2, 5, 8, 10. 75

9. Given a set of 5 problems on power dissipation in resistance, the student will answer 4 correctly. Sample item: A 50 K resistor is connected to the terminals of a 250-volt power supply. What is the power dissipation in the resistor? 80

UNIT IV

Resistors and Ohmmeters

Resistors are used in circuits to provide a specific voltage drop or to control the amount of current. Various types of resistors are manufactured for different requirements. The test instrument most often used to measure resistance is the ohmmeter.

Objectives

I. Goal: The student will know the types and typical applications of standard fixed and variable resistors.

Objective: 1. Given 5 photographs of different resistor types, the student will identify 4 correctly. 80

2. Given 8 statements describing resistor requirements for different circuit applications, the student will select the most appropriate type for each requirement. 75

3. Outside of class, the student will consult an industrial parts catalog to find the following types of resistors:
   a.) Carbon fixed
   b.) Wirewound fixed
   c.) Carbon potentiometer
   d.) Wirewound adjustable

   The student will choose one catalog item for each of the above. He will list the following information for that item: brief description (less than 10 words), catalog number, resistance value, tolerance, dissipation rating,and price. 90

II. Goal: The student will know the resistor color code.

Objective: 4. Given 10 items listing the colors of the 4 bands on a resistor, the student will write the value of the resistor with two significant figures and the per cent tolerance for 7 of the items. 70

III. Goal: The student will understand and be able to apply resistor power ratings.

Objective: 5. The student will show, at the blackboard, the correct solutions for 4 of the following 5 problems on page 174 of the Grob textbook: 1, 2, 6, 7. 8. 80

6. Given 5 multiple choice items on resistor power ratings, the student will answer 4 correctly. Sample item: Two 2200-ohm 2-watt resistors are connected in parallel. Their combined resistance value and wattage rating is

   A. 1100 ohms, 2 watts
   B. 4400 ohms, 4 watts
   C. 1100 ohms, 4 watts
   D. 2200 ohms, 4 watts 80

IV. Goal: The student will understand how to set up an ohmmeter and how to make resistance measurements.

Objective: 7. In the laboratory, the student will perform resistance measurements with an ohmmeter, as described in Experiment No. 2 of the laboratory manual. He will complete the information on the data shee' included in the manual. 90

V. Goal: The student will understand the characteristics and applications of voltage dividers.

Objective: 8. In the laboratory, the student will construct the circuits and perform the voltage divider measurements described in Experiment No. 9 of the laboratory manual. He will complete the data sheet included in the manual. 80

UNIT V

Series Circuits

A series circuit is formed by connecting the leads of the components end-to-end. It has only one path for electron flow. The study of the series circuit is the first step leading to the analysis of more complex circuits.

Objectives

I. Goal: The student will understand and be able to apply the principle of IR voltage drops in a series circuit.

Objective: 1. The student will draw a schematic diagram of a series circuit with a battery and four resistors. He will state in 25 words or less why the current is the same at all points in the circuit. 100

2. The student will show, at the blackboard, the correct solution for at least 2 of the following 3 problems on page 58 of the Grob textbook: 1, 2, 3. 66

3. Given 10 multiple choice questions on series circuits, the student will answer 8 correctly. Sample item: What is the current in a circuit where four resistors of 5, 10, 15, and 20 ohms are connected in series across a 10-volt source?

A. 20 ma
B. 100 ma
C. 200 ma
D. 1000 ma 80

II. Goal: The student will be able to analyze a series circuit with d-c voltage and resistance.

Objective: 4. The student will show, at the blackboard, the correct solution for at least 5 of the following 7 problems on page 58 of the Grob textbook: 4, 5, 6, 7, 8, 9, 10. 70

5. Given a set of 5 problems on series circuits, the student will solve 4 correctly. Sample item: Resistors R1 = 3K and R2 = 2K are connected in series across a 3-volt battery. What is the voltage across R2? 80

6. In the laboratory, the student will perform the measurements and calculations on series circuits in Experiment 4 of the laboratory manual. He will complete the information on the data sheet included in the manual. 80

Unit VI

Parallel Circuits

A parallel circuit is formed by connecting two or more compoments across one voltage source. Each parallel branch is a separate path for electron flow. The study of the parallel circuit is the second step in understanding circuits with greater complexity.

Objectives

I. Goal: The student will understand and be able to apply the rules for branch currents in parallel resistors.

Objective: 1. Given resistors R1, R2, and R3, connected in parallel across a battery with voltage E, the student will use Ohm's law and the rule for total current in parallel circuits to show that $1/R_t = 1/R1 + 1/R2 + 1/R3$, where R_t is the combination of the parallel resistances. 100

2. The student will show, at the blackboard, the correct solution for at least 3 of the following 4 problems on page 72 of the Grob textbook: 1, 3, 6, 10. 75

3. Given 10 multiple choice questions on parallel circuits, The student will answer 8 correctly. Sample item: What is the combined equivalent resistance for a 2-ohm resistor connected in parallel with a 4-ohm resistor?

A. 4/3 ohm
B. 8 ohms
C. 3/4 ohm
D. 1/2 ohm 80

II. Goal: The student will be able to analyze parallel circuits with d-c voltage and resistance.

Objectives: 4. The student will show,at the blackboard, the correct solution for at least 6 of the following problems on page 72 of the Grob textbook: 2, 4, 5, 7, 8, 9, 11, 12. 75

5. Given a set of 5 problems on parallel circuits, the student will solve 4 correctly. Sample item: A circuit consists of 5 equal resistors in parallel. When 80 volts is applied to the circuit, the total current is 2.50 amp. What is the resistance of each branch? 80

6. In the laboratory, the student will perform the measurements on parallel circuits described in Experiment 5 of the laboratory manual. He will complete the information on the data sheet included in the manual.. 80

UNIT VII

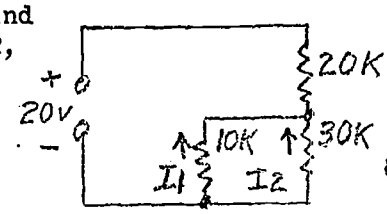
Series-Parallel Circuits

A series-parallel circuit, as the name implies, is a combination of both series and parallel connections. It is important that an electronics technician understand the methods for analyzing currents, voltages, resistance values, and power in this compound circuit.

I. Goal: The student will be able to analyze series-parallel circuits.

Objective: 1. The student will show, at the blackboard, the correct solution for at least 8 of the following 11 problems on page 86 of the Grob textbook: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11. 80

2. Given a set of 5 problems on series-parallel circuits, the student will solve 4 correctly. Sample item: In the circuit at the right, find the value of the current, I2, through the 30K resistor.



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3. Outside of class, the student will design a voltage divider to be used with a 150-volt power supply. The The power supply is to be connected to four loads with the following voltages and currents: (1) 150v, 70ma; (2) 120v, 50ma; (3) 80v, 15ma; (4) 60v, 12ma. Total power supply current is to be 200ma. 75

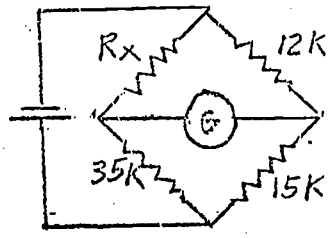
4. In the laboratory, the student will perform the measurements and calculations on compound circuits described in Experiment 6 of the laboratory manual. He will complete the information on the data sheet included in the manual. 80

II. Goal: The student will know Kirchhoff's laws.

Objective: 5. The student will state each of Kirchhoff's laws in 40 words or less. 100

III. Goal: The student will understand voltage and current relations in a Wheatstone bridge.

Objective: 6. Given 3 problems on the Wheatstone bridge circuit, the student will solve 2 correctly.
Sample item: In the circuit at the right, determine the value of R_X to balance the bridge.



UNIT VIII

Direct-Current Meters

Direct-current meters provide a visual interpretation of circuit conditions, including current, voltage, and resistance.The most useful laboratory meters are the volt-ohm-milliammeter (VOM) and the vacuum-tube-voltmeter (VTVM). An understanding of the theory and application of these meters is necessary for accurate measurements and to prevent damage to meters or circuit elements.

I. Goal: The student will understand how to read meter scales. He will know the function of meter range switches.

Objective: 1. In the laboratory, the student will follow the instructions and make the observations indicated for meter scale interpretation and range selection in Experiment 1 of the laboratory manual. He will complete the data sheet included in the manual. 80

II. Goal: The student will understand the use of shunts and multipliers in current meters, voltmeters, and ohmmeters.

Objective: 2. The student will show,at the blackboard, the correct solution for at least 6 of the following 7 problems on page 141 of the Grob textbook: 1, 2, 3, 4, 5, 6, 7. 85

3. Given 5 problems on meter shunts and multipliers, the student will solve 4 correctly. Sample item: Calculate the multiplier resistance needed for a range of 10 volts using a meter movement with 5ma full-scale deflection and 10 ohms series resistance. 80

4. In the laboratory, the student will construct the circuits and perform the measurements and calculations on meter multipliers and shunts in Experiment 7 of the laboratory manual. He will complete the information on the data sheet included in the manual. 80

5. Outside of class, the student will design a volt-ohm-milliammeter using the same meter movement that was measured in Objective 4. Scale readings will be as follows:

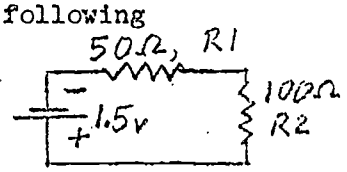
Current measurement, full scale- 1 ma, 10 ma, 100 ma.
Voltage measurement, full scale- 1 v, 10 v, 100 v.
Resistance measurement, half scale- 1500 ohms, 15 Kohms. 150 Kohms.

He will assemble the meter in the laboratory and prepare a table of measurements comparing the readings of his meter with the readings of a standard meter available in the laboratory. Readings will agree to within 5% for at least 7 of the 9 scales. 75

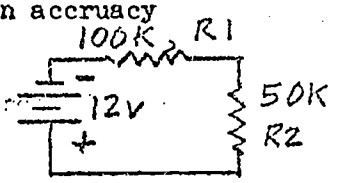
III. Goal: The student will know the appropriate methods for connecting a voltmeter or ammeter in a circuit and will understand the effect of meter loading on accuracy of measurement.

Objective: 6. The student will write answers to the following questions:

a.) In the circuit at the right, it is necessary to measure the current in the loop. Redraw the circuit to show how an ammeter would be connected for the measurement. Show the polarity of the meter terminals. What is the maximum meter resistance for an accruacy of 1%?



b.) In the circuit at the right, it is necessary to measure voltage across R2. Redraw the circuit to show how a voltmeter would be connected for the measurement. Show the polarity of the meter terminals. What is the minimum meter resistance for an accuracy of 1%? 75



7. The student will show, at the blackboard, the correct solution for problems 8 and 9 (3 parts to problem) on page 141 of the Grob textbook. 75

IV. Goal: The student will understand the characteristics and applications of multifunction meters.

Objective: 8. Given 5 statements describing measurement requirements, the student will indicate which type of meter would be most appropriate for the measurement, the VOM or the VTVM. 80

9. In the laboratory, the student will construct the circuits and perform the measurements with a multifunction meter, as described in Experiment 8 of the laboratory manual. He will complete the information on the data sheet included in the manual. 80

UNIT IX

Network Theorems

An electrical network includes elements interconnected to form many branches with one or more sources of current or voltage. Kirchhoff's laws provide methods for solution of any type of network. Network theorems, including Thevenin's, Norton's, superposition, and Δ-Y, are often used to transform complex networks to simpler forms for analysis.

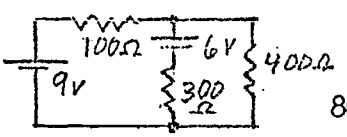
In this unit, network theorems are applied to resistance circuits with d-c sources. The same methods are also important in analyzing a-c circuits.

Objectives

I. Goal: The student will be able to apply Kirchhoff's laws to analyze circuits.

Objective: 1. The student will show, at the blackboard, the correct solution for at least 2 of the following 3 problems in the Grob textbook: 8, 9, 12. 66

2. Given 5 circuit analysis problems, the student will find the solution to at least 4 of the problems. Sample item: In the circuit at the right, find the current through the 400-ohm resistor.



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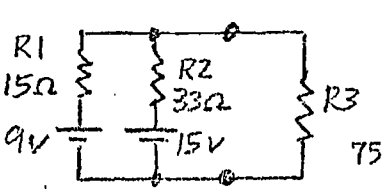
3. In the laboratory, the student will connect the circuits and perform the measurements on loops and nodes, as described in Experiment 16 of the laboratory manual. He will complete the data sheet on the experiment. 80

II. Goal: The student will understand and be able to apply Thevenin's theorem.

Objective: 4. The student will state Thevenin's theorem in 75 words or less. The statement should include the method of determining equivalent elements. 100

5. The student will show, at the blackboard, the correct solution for at least 3 of the following 4 problems on page 112 of Grob's textbook: 1, 3, 4, 6. 75

6. Given a set of 4 circuit problems, the student will use Thevenin's theorem to solve at least 3 correctly. Sample item: In the circuit at the right, find the Thevenin equivalent circuit seen by R3.



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7. In the laboratory, the student will perform the measurements and calculations using Thevenin's theorem, as described in Experiment 11 of the laboratory manual. He will complete the data sheet on the experiment. 80

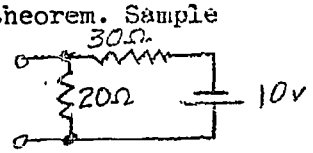
8. In the laboratory, the student will apply Thevenin's theorem to the problem of maximum power transfer, as described in Experiment 12 of the laboratory manual. He will complete the data sheet on the experiment. 80

III Goal: The student will understand and be able to apply Norton's theorem.

Objective: 9. The student will state Norton's theorem in 75 words or less. The statement will include the method of determining equivalent elements. 100

10. The student will show, at the blackboard, the correct solution for at least 2 of the following 3 problems on page 112 of the Grob textbook: 2, 5, 7. 66

11. Given a set of 4 circuit problems, the student will solve 3 correctly using Norton's theorem. Sample item: Find the Norton equivalent for the circuit at the right.

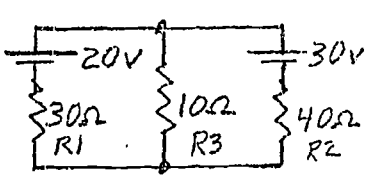


12. In the laboratory, the student will apply Norton's theorem in the measurements and calculations described in Experiment 13 of the laboratory manual. He will complete the data sheet on the experiment. 80

IV. Goal: The student will understand and be able to apply the superposition theorem.

Objective: 13. The student will state the superposition theorem in 50 words or less. 100

14. Given a set of 4 circuit problems, the student will use the superposition theorem to solve at least 3 correctly. Sample item: In the circuit at the right, find the current in R3.



15. In the laboratory, the student will apply the superposition theorem as described in Experiment 10 of the laboratory manual. He will complete the data sheet on the experiment. 80

V. Goal: The student will understand and be able to apply delta-wye transformations

Objective: 16. The student will show, at the blackboard, the correct solutions to problems 10 and 11 on page 112 of the Grob textbook. Each problem has 3 parts. 66

17. Given the equations for Δ-Y transformation, the student will apply the equations to convert a Y network to a Δ and a Δ network to a Y. 66

UNIT X

Conductors and Insulators

Conductors have very low resistance. They are used in electric circuits to connect electric elements with minimum IR drop between the source and the load. Insulators, on the other hand, have very high resistance. They prevent current flow between electrical elements.

Current may be carried by electrons in solid conductors, by ions in liquids and gases, and by electrons and holes in semiconductors. It is necessary for electronics technicians to be familiar with these three means of conduction. They must also be familiar with frequently used component types which employ the principle of electron conduction in solids. Switches, fuses, and pilot lamps are included in this unit of study.

Objectives

I. Goal: The student will know the function and types of conductors. He will be able to calculate wire resistance from resistivity and wire size.

Objective: 1. Given a list of statements describing different types of wire and cable, the student will select the correct name which applies to each statement. 90

2. Outside of class, the student will consult an industrial parts catalog to find the following types of wire and cable:
   a. Radio hookup wire
   b. Bus bar
   c. Magnet wire
   d. Coaxial cable
   e. Twin-line for TV

   The student will choose one catalog item for each type. He will list the following information on the item: Brief description (less than 10 words), catalog number, quantity, and price. 90

3. The student will show, at the blackboard, the correct solutions for at least 5 of the following 7 problems on pages 159-160 of the Grob textbook: 1, 4, 8, 9, 11, 12. 70

4. Given a set of 5 problems on wire resistance, the student will solve 4 correctly. Sample item: What is the resistance of 20 feet of No. 22 gage copper wire? (Diameter = 25.4 mils, specific resistance = 10.4 circular-mils per ft.) 80

II. Goal: The student will know the types of switches, fuses, and pilot lamps.

Objective: 5. Outside of class, the student will consult an industrial parts catalog to find the following items:

a. Double-pole, double-throw toggle switch
b. Single-pole, double-throw lever switch
c. 4-pole, 2-position rotary switch
d. Slow-blow fuse
e. Incandescent pilot lamp

The student will choose one calatog item for each of the above. He will list the following information on each item: Brief description (less than 10 words), catalog number, voltage and current rating, and price. 90

6. The student will show, at the blackboard, the correct solutions to the following problems on pages 159-160 of the Grob textbook: 2 (3 parts), 3 (3 parts), 5. 85

7. In the laboratory, the student will construct the circuits, make the observations, and complete the design problems on characteristics and ratings of switches, as described in Experiment 19 of the laboratory manual. He will complete the information on the data sheet. 80

III. Goal: The student will know the characteristics of ion current and of electron and hole current in semiconductors.

Objective: 8. Given a list of statements descriptive of current flow, the student will select the appropriate term to identify the type of current flow. 80

9. The student will show, at the blackboard, the correct solutions to problems 6 and 7 (3 parts) on page 160 of the Grob textbook. 75